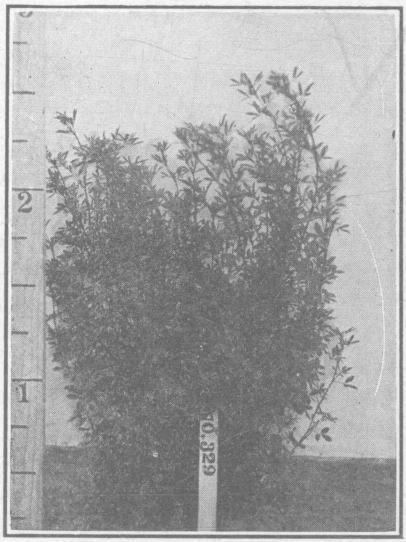
ALFALFA IN OHIO.

ALFALFA AT THE EXPERIMENT STATION.
DATE OF SEEDING, USE OF THE NURSE CROP,
LIMING, MANURING AND FERTILIZING.
EXPERIENCE OF OHIO FARMERS WITH ALFALFA.

OHIO
Agricultural Experiment Station.

WOOSTER, OHIO, U. S. A., APRIL, 1907.

BULLETIN 181.



The Bulletins of this Station are sent free to all residents of the State who request them. Persons who desire their addresses changed should give both old and new address. All correspondence should be addressed EXPERIMENT STATION, Wooster, Ohio.

OHIO AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

G. E. JOBE, *President* ..... Cedarville
GEORGE E. SCOTT ..... Mt. Pleasant
CHARLES FLUMERFELT ..... Old Fort
MARTIN L. RUETENIK ..... Cleveland
JAMES DEVOL ..... Marietta

WILLIAM H. KRAMER, *Secretary-Treasurer*

STATION STAFF

CHARLES E. THORNE, M. S. A., *Director*

ADMINISTRATION

THE DIRECTOR, *Chief*
WILLIAM H. KRAMER, *Bursar*
W. K. GREENBANK, *Librarian*
CLARENCE M. BAKER, B. S., *Editor*

AGRONOMY

C. G. WILLIAMS, *Associate Director, Chief*
F. A. WELTON, M. S., *Associate*
J. B. PARK, Ph. D., *Hon. Associate*[1]
WILLIAM HOLMES, *Farm Manager*
C. A. PATTON, *Assistant*
L. E. THATCHER, Ph. G., *Assistant*

ANIMAL HUSBANDRY

B. E. CARMICHAEL, M. S., *Chief*
J. W. HAMMOND, M. S., *Associate*
W. J. BUSS, *Assistant*
W. L. ROBISON, M. S., *Assistant*

BOTANY

A. D. SELBY, B. S., *Chief*
TRUE HOUSER, B. S., *Asst.* (Germantown)
FREDA DETMERS, M. S., *Assistant*
ROY C. THOMAS, M. A., *Assistant*

CHEMISTRY

J. W. AMES, M. S., *Chief*
C. J. SCHOLLENBERGER, *Assistant*
MABEL K. CORBOULD, *Assistant*
RAUB H. SIMON, A. M., *Assistant*

CLIMATOLOGY

W. H. ALEXANDER, *Chief* (Columbus)[2]
C. A. PATTON, *Observer*

DAIRYING

C. C. HAYDEN, M. S., *Chief*
A. E. PERKINS, M. S., *Assistant*

ENTOMOLOGY

H. A. GOSSARD, M. S., *Chief*
HERBERT OSBORN, D. Sc., *Hon. Associate*[1]
J. S. HOUSER, M. S. A., *Associate*
W. V. BALDUF, B. A., *Assistant*

FORESTRY

EDMUND SECREST, B. S., *Chief*
J. J. CRUMLEY, Ph. D., *Assistant*
F. W. DEAN, B. S., *Assistant*

HORTICULTURE

W. J. GREEN, *Vice Director, Chief*
PAUL THAYER, M. S., *Associate*
F. H. BALLOU, *Assistant* (Newark)
J. B. KEIL, *Field Assistant*
I. P. LEWIS, B. S., *Field Assistant*
C. W. ELLENWOOD, *Field Assistant*

NUTRITION

E. B. FORBES, Ph. D., *Chief*
J. A. SCHULZ, B. S., *Assistant*
E. B. WELLS, B. S., *Assistant*
A. R. WINTER, B. S., *Assistant*

SOILS

THE DIRECTOR, *Chief*
C. G. WILLIAMS, *Associate in soil fertility*
J. W. AMES, M. S., *Asso. in soil chemistry*
F. E. BEAR, Ph. D., *Hon. Associate*[1]
A. BONAZZI, B. Agr., *Assistant*
G. W. CONREY, A. M., *Assistant*[1]

FARM MANAGEMENT

C. W. MONTGOMERY, *Chief*

DISTRICT EXPERIMENT FARMS

Northeastern Test-Farm, Strongsville
D. S. KIRBY, *Foreman*

Southwestern Test-Farm, Germantown
HENRY M. WACHTER, *Manager*

Southeastern Test-Farm, Carpenter
S. C. HARTMAN, M. S., *Superintendent*
C. H. WILSON, *Manager*

Northwestern Test-Farm, Findlay
JOHN A. SUTTON, *Manager*

COUNTY EXPERIMENT FARMS

Miami Co. Experiment Farm, Troy
Madison Co. Experiment Farm, London
.....*Supt.*, London

Paulding Co. Experiment Farm, Paulding
H. R. HOYT, *Manager*, Wooster.

Clermont Co. Experiment Farm, Owensville
Hamilton Co. Experiment Farm, Mt. Healthy
H. W. ROGERS, *Supt.*, Mt. Healthy

Washington Co. Experiment Farm, Fleming
Washington Co. Truck Experiment Farm, Marietta
S. C. HARTMAN, M. S., *Supt.*, Marietta

Mahoning Co. Experiment Farm, Canfield
Trumbull Co. Experiment Farm, Cortland
J. PAUL MARKLEY, *Supt.*, Canfield

Belmont Co. Experiment Farm, St. Clairsville
C. W. MONTGOMERY, *Acting Supt.*, Wooster

STATE FORESTS

Waterloo State Forest, New Marshfield
Dean State Forest, Steece

---

[1]In cooperation with the College of Agriculture, Ohio State University, Columbus.
[2]In cooperation with the U. S. Department of Agriculture.

BULLETIN
OF THE
Ohio Agricultural Experiment Station

NUMBER 181. APRIL, 1907.

ALFALFA IN OHIO.

ALFALFA AT THE EXPERIMENT STATION.

BY C. G. WILLIAMS AND C. H. KYLE.

1903.

In the spring of 1903 this Station put out an alfalfa test of four acres in which the value of lime, manure, various forms of commercial fertilizers and inoculation were studied. Forty tenth-acre plots were used in this work. The ground was a new clover sod, one year from seeding. It was plowed early in April and seeded May 1st, at the rate of 24 lbs. of alfalfa seed per acre, without a nurse crop. The weather remained exceedingly dry for 28 days after seeding and the alfalfa came slowly and somewhat unevenly. The foxtail proved a stronger competitor for the ground than the alfalfa. The field was clipped four times between June 17th and August 31st, but the clipping only served to diminish the number of alfalfa plants and to increase the vigor of the foxtail.

Caustic lime was used at the rate of 800 lbs. per acre upon half of the area, applied just previous to seeding. Half the area was inoculated by the use of an application of 200 lbs. of soil per acre from the oldest alfalfa field in the state (sown in the eighties). Different plots received an application of eight tons of stable manure per acre, but the various sorts of treatment seemed of no avail. The foxtail took the ground save here and there a little patch of a few square feet. The treatment did not afford any explanation for the existence of these patches. Examination made September 15th for the presence of bacteria working upon the roots of the alfalfa revealed the fact that there were none, save on an occasional plant in the *inoculated area*. It was as near a total failure as could well be.

1904.

Owing to the failure of the first year's seeding, the plots were all plowed up in the spring of 1904 and seeded again May 10th. No changes were made in the fertilization and liming. The seed was sown crosswise of the plots, thus permitting a test of a nurse crop

and seed inoculation without interfering with the lime and fertilizer test. Upon a portion of the area a nurse crop of oats was seeded at the rate of 28 quarts per acre, and a portion of the alfalfa seed used was treated with inoculating material received from the United States Department of Agriculture. The seed came up quite evenly and for the first two months the area seeded without a nurse crop led in growth, but by fall there was no noticeable difference as between nurse crop and no nurse crop. There were no apparent results from the inoculation of the seed.

The greatest difficulty in the way of securing a stand this year, as last, was the foxtail. The limed portions showed a very much better stand and larger growth of alfalfa than the unlimed. The latter was about as great a failure as the year previous. It was quite evident that the greatest need of this soil was lime, and in somewhat larger amounts than the application used, viz, 800 lbs. per acre.

It was decided to leave a portion of each of the 40 plots (one end) for the harvest of 1905, but to plow the larger part, lime all more thoroughly and seed at different times in order that the effect of date of seeding might be studied in relation to weed competition.

1905.

The plowing for the seeding of 1905 was done April 26th. The plots were limed May 1st. For the amounts applied see Table III. The amounts as given represent the total application to date. The plots were harrowed thoroughly and one-half of each of the 40 plots was seeded May 24th without a nurse crop. The unseeded portion of these plots was harrowed at intervals of two or three weeks until July 6th, when the second seeding was made. About one-fourth of each of the original 40 plots was seeded at this date. The harrowing was continued on the remaining portion until August 3rd, when the final seeding was made. No nurse crop was used on any of the seedings. Conditions of seeding were made as nearly alike as possible. The May seeding had the usual competition with foxtail. The plots were clipped as necessary to keep this weed from seeding. Both the July and August seedings started off promptly without any weed competition. By September the July seeding was 10 to 12 inches high. It was clipped September 9th. This clipping was not removed, though it doubtless would have been saved for hay but for unfavorable weather. The August seeding was not clipped. Both the July and August seedings went into the winter in most excellent condition, with a growth of 8 to 10 inches. While portions of the May seeding were good, as a whole it was much inferior and large portions were apparently ruined.

In Table I the plot yields of the unsuccessful seeding of 1904 are given.

TABLE I—ALFALFA HARVEST OF 1905.

Plot No.	Application to soil per acre.						Yield of alfalfa per acre.	
	Acid phosphate	Sodium nitrate	Potassi'm chloride	Stable manure	Caustic lime	Inoculated soil	First cutting	Second* cutting
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	.....	.....	.....	.....	.....	.....	.....	.....
2	320	.....	.....	.....	.....	.....	679†	.....
3	320	.....	60	.....	.....	.....	291	.....
4	.....	.....	.....	.....	.....	.....	291	.....
5	320	80	60	.....	.....	.....	340	.....
6	320	80	.....	.....	.....	.....	291	.....
7	.....	.....	.....	.....	.....	.....	194	.....
8	.....	.....	.....	16,000	.....	.....	194	.....
9	160	.....	.....	8,000	.....	.....	194	.....
10	.....	.....	.....	.....	.....	.....	194	.....
Average yield per acre of the 10 plots.							296	679
11	.....	.....	.....	.....	8,000	.....	1,406	.....
12	320	.....	.....	.....	8,000	.....	1,697	.....
13	320	.....	60	.....	8,000	.....	1,358	.....
14	.....	.....	.....	.....	8,000	.....	1,164	.....
15	320	80	60	.....	8,000	.....	1,600	.....
16	320	80	.....	.....	8,000	.....	1,697	.....
17	.....	.....	.....	.....	8,000	.....	1,576	.....
18	.....	.....	.....	16,000	8,000	.....	1,746	.....
19	160	.....	.....	8,000	8,000	.....	1,576	.....
20	.....	.....	.....	.....	16,000	.....	1,988	.....
Average yield per acre of the 10 plots.							1,581	1,649
21	.....	.....	.....	.....	.....	195	48	.....
22	320	.....	.....	.....	.....	195	97	.....
23	320	.....	60	.....	.....	195	84	.....
24	.....	.....	.....	.....	.....	195	145	.....
25	320	80	60	.....	.....	195	194	.....
26	320	80	.....	.....	.....	195	291	.....
27	.....	.....	.....	.....	.....	195	181	.....
28	.....	.....	.....	16,000	.....	195	194	.....
29	160	.....	.....	8,000	.....	195	97	.....
30	.....	.....	.....	.....	.....	695	242	.....
Average yield per acre of the 10 plots.							157	776
31	.....	.....	.....	.....	800	195	1,261	.....
32	320	.....	.....	.....	800	195	1,843	.....
33	320	.....	60	.....	800	195	1,867	.....
34	.....	.....	.....	.....	800	195	1,382	.....
35	320	80	60	.....	800	195	2,085	.....
36	320	80	.....	.....	800	195	1,455	.....
37	.....	.....	.....	.....	800	195	1'018	.....
38	.....	.....	.....	16,000	800	195	1,576	.....
39	160	.....	.....	8,000	800	195	1,067	.....
40	.....	.....	.....	.....	800	695	703	.....
Average yield per acre of the 10 plots.							1,426	2,474

*In the second cutting the plots were not weighed separately.
†This plot occupies the site of an old lane.

1906.

These various seedings came through the winter in good condition. The July and August seeding was quite uniformly good. The May seeding was good in places but a great many plots of it were destroyed, as will be seen from the following table:

TABLE II—ALFALFA HARVEST OF 1906.

Plot No.	Kinds of fertilizer used	Pounds of alfalfa hay per acre.						Total yield per acre	
		1st cutting, June 11		2nd cutting, July 19		3rd cutting, Aug. 30			
		May seeding	July and Aug. seeding	May seeding	July and Aug. seeding	May seeding	July and Aug. seeding	May seeding	July and Aug. seeding
	2,500 pounds of lime per acre.								
1	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	P.....	*6,004	.....	2,441	.....	3,240	.....	11,686	.....
3	P. K.....	*5,767	.....	2,678	.....	2,700	.....	11,145	.....
4	None.....	4,276	.....	1,642	.....	2,376	.....	8,294	.....
5	P. K. N....	3,952	.....	1,620	.....	2,333	.....	7,905	.....
6	P. N.....	3,974	.....	1,771	.....	2,376	.....	8,121	.....
7	None.....	3,909	.....	1,836	.....	2,549	.....	8,294	.....
8	M.....	4,341	.....	2,052	.....	2,383	.....	8,776	.....
9	P. & M.....	4,740	4,800	2,042	1,513	2,742	1,271	9,524	7,584
10	None.....	4,140	5,700	2,118	2,481	2,553	1,997	8,811	10,178
Av. yield per acre.		4,545		2,020		2,564		9,129	
	5,000 pounds of lime per acre.								
11	None.....	3,820	4,820	2,326	2,884	2,685	2,118	8,831	9,822
12	P.....	4,640	5,380	2,326	2,763	2,647	2,259	9,613	10,402
13	P. K.....	4,680	5,320	2,364	2,965	2,647	2,380	9,691	10,665
14	None.....	3,260	4,900	1,797	2,461	2,402	2,118	7,459	9,479
15	P. K. N....	3,880	4,860	2,004	2,521	2,572	2,078	8,456	9,459
16	P. N.....	4,020	5,320	1,872	2,521	2,402	2,158	8,294	9,999
17	None.....	3,400	4,680	1,853	2,340	2,364	1,997	7,617	9,017
18	M	4,220	5,020	1,702	2,481	2,572	2,097	8,494	9,598
19	P. & M	3,440	4,600	1,702	2,259	2,572	2,017	7,714	8,876
20	None.....	2,820	4,260	1,796	2,340	2,609	1,997	7,225	8,597
Av. yield per acre		3,818	4,916	1,974	2,554	2,547	2,122	8,339	9,591
	2,500 pounds of lime per acre.								
21	None.....	3,140	3,940	1,759	2,340	2,458	1,997	7,357	8,277
22	P.....	3,520	4,720	1,948	2,481	2,364	1,936	7,832	9,131
23	P. K.....	3,880	4,840	2,042	2,925	2,496	2,097	8,418	9,862
24	None.....	2,940	3,880	1,740	2,340	2,553	1,936	7,233	8,156
25	P. K. N....	3,760	4,840	2,023	2,783	2,534	1,916	8,317	9,539
26	P. N.....	3,900	4,560	2,080	2,703	2,610	1,997	8,590	9,260
27	None.....	2,920	3,720	1,796	2,098	2,420	1,714	7,136	7,532
28	M	3,640	4,960	1,740	2,662	2,364	2,521	7,744	10,143
29	P. & M.....	3,460	2,480	1,759	2,582	2,269	2,521	7,488	7,583
30	None.....	1,985	4,540	1,248	2,662	2,088	2,420	5,321	9,622
Av. yield per acre		3,315	4,248	1,814	2,558	2,416	2,106	7,544	8,911

TABLE II—ALFALFA HARVEST OF 1906.—(Continued.)

Plot No.	Kinds of fertilizer used	Pounds of alfalfa hay per acre. 1st cutting, June 11		2nd cutting, July 19		3rd cutting, Aug. 30		Total yield per acre	
		May seeding	July and Aug. seeding	May seeding	July and Aug. seeding	May seeding	July and Aug. seeding	May seeding	July and Aug. seeding
		3,500 pounds of lime per acre.							
31	None.....	1,960	3,660	1,210	2,219		1,977	3,170	7,856
32	P.....	1,360	6,080	1,040	2,824		2,017	2,400	10,921
33	P. K.....	1,500	4,700	1,361	2,945	Nearly	2,320	2,861	9,965
34	None.....	900	4,420	1,097	3,267	all	2,380	1,997	10,067
35	P. K. N.....	900	5,020	1,229	3,267	weeds.	2,481	2,129	10,768
36	P. N.....	380	4,860	908	3,207	Not	2,118	1,288	10 185
37	None.....	920	4,060	927	2,481	saved	2,057	1,847	8,598
38	M.....	460	5,240	775	3,086		2,763	1,235	11,089
39	P. & M.....	600	5,680	794	3,025		2,320	1,394	11,026
40	None.....	760	4,740	794	2,138		2,017	1,554	8,895
Av. yield per acre		974	4,846	1,014	2,846		2,245	1,988	9,937
Av. yield of all plots		3,089	4,703	1,689	2,647	1,846	2,152	6,625	9,502
Av. yield of fertilized plots.....		3,316	4,916	1,749	2,778	1,873	2,222	6,939	9,915
Av. yield of unfertilized plots.....		2,743	4,409	1,596	2,465	1,804	2,056	6,143	8,930

*Damp when weighed. † Unfair to late seeding and entire plot omitted in averages.
P—Phosphorus. K—Potassium. N—Nitrogen. M—Manure.

For the specific amount of fertilizing materials used on these plots see Table I.

The first eight plots reported upon in Table II. contain only one-twentieth acre each, and accordingly the entire plot was seeded at the May seeding. The end of plot 9, seeded in July and August, is injured by apple trees and previous washing, and the yield of alfalfa is omitted in the averages. Upon plots 31–40 the May seeding was taken by the foxtail and crab grass. The third cutting was practically all weeds and was not weighed. In remarkable contrast are the ends (halves) of these same plots which were seeded six and ten weeks later, after the land had been cleaned by repeated harrowings. In other ways the treatment was identical.

Owing to the unevenness of the May seeding the July and August seedings offer more reliable data for comparing the value of the different fertilizers used. In Table III. the average yields per acre of the three plots treated as indicated, are given.

TABLE III—THE EFFECT OF COMMERCIAL FERTILIZERS AND STABLE MANURE ON YIELD OF ALFALFA, THE AVERAGE APPLICATION OF LIME BEING 3,666 LBS. PER ACRE.

Plots	Fertilizing materials applied per acre	Cost per acre	Av. lbs. of alfalfa per acre 3 cuttings	Lbs. of increase over unfertilized plots	Value of increase per acre the first year at $12 per ton
12-22-32	320 lbs. Acid phosphate.....	$2.40	10.151	1,221	$7.33
13-23-33	320 lbs. Acid phosphate 60 lbs. Potassium chloride	3.75	10,164	1,234	7.40
16-26-36	320 lbs. Acid phosphate 80 lbs. Sodium nitrate	4.20	9,815	885	5.31
15-25-35	320 lbs. Acid phosphate 60 lbs. Potassium chloride 80 lbs. Sodium nitrate	5.55	9,921	991	5.95
18-28-38	8 tons of manure.....		10,277	1,347	8.08
19-29-29	160 lbs. Acid phosphate 4 tons manure		9,162	232	1.39
13 plots	Without fertilizer.....		8,930		

The average yield of plots 19, 29 and 39 is lower than would be expected considering the yields from the full application of acid phosphate and manure upon the other plots of the series. One of the three, plot 39 (Table II.) gives a total yield of 11,026 lbs., which is about what one would have reason to expect. It is probable that some unknown inequality exists which has caused the very low yield upon plot 29 of this series, thus cutting down the average for the three plots.

EXPERIENCE OF ALFALFA GROWERS THROUGHOUT THE STATE.

To obtain a clearer and more definite comprehension of Ohio's present successes and future possibilities as an alfalfa state, the following list of questions was sent to numerous growers in the various sections of the state:

QUESTIONS.

1 How many acres of alfalfa have you now upon your farm?
2 How many years experience have you had in growing alfalfa?
3 When was your present acreage seeded?
4 What is the character of the soil on which it is growing? (Clay, sand or muck.)
5 Is it rich in humus?
6 How deep is it?
7 What is the character of the sub-soil?
8 What is your underlying rock?
9 How many feet is the rock below the surface?
10 Do you find limestone gravel in your surface soil? In your sub-soil? Is there limestone anywhere in your locality?
11 How deep do you have to go to find water?
12 Have you good drainage in your alfalfa fields? Natural or artificial?
13 Is your alfalfa grown on bottom land, second bottom, or upland?
14 Is it subject to overflow?
15 How many days in succession have you had alfalfa fields under water and with what result?
16 How many years was land under cultivation before alfalfa was grown upon it?

17 What was the general rotation followed?
18 Was clover grown successfully upon this land?
19 What crop immediately preceded the alfalfa?
20 Have weeds given you much trouble in your cultivated fields?
21 If so, what have been your worst pests?
22 At what time of the year was land plowed for alfalfa? How deep?
23 What, if any, applications of manure or other fertilizers were made?
24 When were they made? At what rate per acre?
25 If commercial fertilizers were used, give the analysis.
26 Did you use lime? If so, in what form and at what rate per acre?
27 What, if any, difference did you note where lime was applied?
28 Give date of seeding.
29 What, if any, implement was used in distributing seed? In covering seed?
30 Number of pounds of seed used per acre?
31 From whom was seed purchased?
32 Where was the seed grown?
33 Was seeding made with, or without nurse crop?
34 If with, what nurse crop was used and what was the rate of seeding?
35 Was nurse crop allowed to ripen seed, or was it cut for hay?
36 What was the yield of nurse crop per acre? Tons of hay? Bushels of grain?
37 How many times did you clip the alfalfa the first season? Was any hay removed?
38 When was the last clipping made?
39 What was the height of the alfalfa plants at the beginning of winter?
40 Was alfalfa injured to any extent by weeds?
41 Have you noticed any difference in the ability of late seeding to withstand winter as compared with early seeding?
42 Did you inoculate for alfalfa?
43 If so, in what way and with what result?
44 Does sweet clover grow naturally on your farm, or in your locality?
45 Have you ever tested your soil for acidity and if so with what result?
46 At what stage of growth do you cut alfalfa?
47 Any exceptions to your general rule?
48 After the first year how many crops harvested each season?
49 What has been your average yield each cutting? For each year?
50 Have you noted any difference in the feeding value of the different cuttings?
51 Have you found the later growth injured by cutting alfalfa too young?
52 By cutting it too mature?
53 Have you had any experience in pasturing alfalfa?
54 What effect has it had upon the growth and life of the plant?
55 Have you ever made silage of alfalfa and if so with what success?
56 Have you used alfalfa for soiling and with what result?
57 Have you made any careful tests as to the comparative feed value of alfalfa and red clover or soy bean hay? Give results.
58 Do you find any demand for alfalfa hay, if so, what are the prices paid per ton?
59 Have you had experience in growing a seed crop?
60 If so, which cutting have you saved, how have you handled it, and what has been your yield per acre?
61 Mention any conditions or circumstances which have interfered with the successful growth of alfalfa on your farm.
62 Mention any methods of seeding which you have tried and failed to secure a stand.
63 In the light of your experience and observation what changes would you make in future seedings?
64 Kindly give names and addresses of any alfalfa growers in your locality.
65 Have you had any trouble from alfalfa roots stopping tile drains?
66 Is there water in your tiles all the time or are they dry a portion of the year?

We highly prize the information which has come to us in answer to these questions, and while we wished for a much higher per cent of answers from the many alfalfa growers whom we addressed, we feel that the experience of the 400 and more practical men, who represent every section and condition in the state, can not help but furnish much encouragement as well as valuable information to all.

In this compiled report we have endeavored to present the individual experiences, as given by the many growers, in such a collective form that they will have the most weight and at the same time show the great variability of success which prevails under every condition. It has been necessary, of course, to discard a great deal of experience because some one or more of the questions have not been answered, or have been answered only in an indefinite way. However, we feel that the evidence which is presented may be depended upon as having decided weight.

Answers to the list of alfalfa questions have been returned from about 70 counties in the state, and practically all parts of the state are represented. It is also known that all counties in the state, with the two exceptions of Monroe and Vinton, are now growing alfalfa. This fact, that alfalfa is growing successfully over a so widely distributed area in the state, should carry with it much encouragement and perhaps new hope for the man who has been taught that Ohio has not a climate which is suited to the culture of this crop.

The average length of time, during which alfalfa has been grown by those filling out the question blanks, covers a period of 4 years, and ranges from 1 to 20 years. The area devoted to alfalfa at the present time varies from 1 acre to 300 acres, the average for all being about 9 acres. This amounts to about 3,700 acres under the control of those reporting, and is, probably, from 25 to 35 per cent of the total area growing in the state.

The average age of the alfalfa now growing upon the farms considered is 3½ years, and the oldest alfalfa growing is said to be 16 years old. Many could not give definite answers as to the yields they had secured, but of those who did, the average annual yield amounts to 3.9 tons per acre.

Many reported that there was a demand for alfalfa in their locality, but few had the hay for sale, because they desired it for their own use. We found, however, that from $5.00 to $20.00 per ton had been paid for the hay and that the average price, in the 194 cases reporting, was $11.00.

With the above average price and the above average yield, it will be seen that those who have reported have been getting a gross return of $42.90 per acre each year, from their land devoted to alfalfa with the exception, in most cases, of the first season. When it is considered that alfalfa will continue to grow and produce, under suitable conditions, for a number of years with but one preparation of the seed-bed and but one seeding, it will be seen that it is a very profitable crop in Ohio. So striking are these figures, coming as they do from practical growers all over the state, that it would seem that the working details

of those of experience are much to be desired, and in the discussion which follows we hope to present Ohio's experience and observation in such a way that those questions, relating to alfalfa, now uppermost in the minds of farmers, will be answered as far as possible.

ALFALFA SOIL.

The soil, in 54 per cent of the cases reported, was said to be of a more or less clayey nature; in 16 per cent of the cases it tended more or less to sand, while 8 per cent of the alfalfa was growing on muck land. About 22 per cent of the alfalfa is growing on land which was not definitely described.

In the table which follows the data for clay and sandy soils are separately compared for upland, first bottom and second bottom. The number of acres, the number reporting, the number whose yields were less than 2½ tons per acre, the number whose yields were 4½ tons or more per acre and the average yield per acre are given for each class of soils.

TABLE IV—ALFALFA ON CLAYEY AND SANDY SOILS; ON BOTTOM AND UPLAND.

Soil	Elevation	Number of acres	Number of reports			Average yield tons per acre
			Total	Below 2½ tons per acre	4½ tons or more per acre	
Clayey...	First bottom	161	17	1	5	3.68
	Second bottom	196	11	0	1	3 63
	Upland	713	91	10	28	3 75
	Average					**3.69**
Sandy...	First bottom	247	24	2	15	4.54
	Second bottom	73	14	0	7	4.36
	Upland	63	11	4	2	2 98
	Average					**3.96**

Muck soils are not represented in this table because of insufficient data. The first bottom muck soil is represented in 9 cases and by 55 acres, but the second bottom is not represented at all, while upland muck is reported in two cases and represented by 5 acres. The average yield on upland muck was 3 tons per acre, and that on first bottom was 3.36 tons per acre. On first bottom, one field of muck yielded less than 1½ ton per acre and one field yielded more than 4½ tons.

It appears in Table IV that sandy first bottom was 23 per cent more productive than clay first bottom, and that sandy second bottom was 20 per cent more productive than clay second bottom, but that sandy upland was 26 per cent less productive than clay upland. It will be noticed that in every combination of conditions some fields have been made to produce 4½ tons or more per acre while, with the exception of second bottom, some in each instance have given less

than 2½ tons per acre. It should be noticed in particular that clay upland is subject to the greatest variation. It is quite evident from these figures that in producing alfalfa, as has been found true in the production of other crops, clay soil is more susceptible to treatment than the sandy soils, and on upland, clays are far superior to sandy soils for maintaining a sufficient supply of moisture during the summer months.

The most serious objection coming from alfalfa growers, in regard to clay soils, is their tendency to heave the young plants out of the ground when there are repeated freezes and thaws. There were 19 who have reported injuries from freezing or thawing. Five of these merely stated that late seeding tends to heave more than early seeding, without giving any of the particulars concerning their soil conditions at the time. The other 14 had seeded early and upon clay land (one exception—muck soil) and it was observed that the land was either poor in humus, or that there was very poor drainage. A possible solution for this difficulty with clay is indicated by these facts.

DRAINAGE.

In Table V the influence of the different kinds of natural drainage upon the growth of alfalfa is compared. In all cases the drainage is said to be good, but the so-called natural surface drained land has a clay sub-soil, while the so called sub-surface drained land has a porous sub-soil.

TABLE V—EFFECT OF NATURAL SURFACE AND SUB-SURFACE DRAINAGE.

Elevation	Drainage	Number of acres	Number of Reports			Average yield, tons per acre
			Total	Below 2½ tons per acre	4½ tons or more per acre	
First bottom....	Natural surface.....	58	9	0	3	4 00
	Natural sub-surface..	219⅔	22	1	14	4 73
Second bottom...	Natural surface	24	3	0	1	3 83
	Natural sub-surface.	69	13	0	6	4.23
Upland.....	Natural surface.....	162½	27	4	9	3.67
	Natural sub-surface..	70½	12	3	2.	3 00

It will be seen that the natural sub-surface drained soil on first bottom yielded 0.73 of a ton more per acre than did the natural surface drained soil on first bottom, and on second bottom the difference in favor of the natural sub-surface drainage is 0.60 of a ton per acre. However, upon upland soil it will be noticed that the order of yields is reversed, and that the surface drained soil yielded 0.67 of a ton per acre more than the natural sub-surface drained soil.

It seems that while the yields are good, even on surface drained land of first and second bottoms, the yields are increased when a porous sub-soil is present. The surface drained upland gives yields which are less than those produced by the surface drained soil of first and second bottoms. The most marked decrease in prductiveness, though, comes from the upland with porous sub-soil. It is evident that the drainage from this latter class of soils is excessive. Fully 50 per cent of the losses and injuries credited to dry weather have been found on this sort of land.

EFFECT OF TILE DRAINAGE.

In Table VI the yields coming from clay upland that has been tiled and clay upland that has not been tiled, are compared.

TABLE VI—EFFECT OF TILE DRAINAGE ON CLAY UPLAND.

	Number of acres	Number of reports	Below 2½ tons per acre	4½ tons or more per acre	Average yield per acre, tons
Clay upland tiled	221.0	24	2	8	4.0
Clay upland untiled	118.5	20	3	5	3.58

It appears that tile drainage has increased the yield by 0.42 of a ton per acre, or 12 per cent. We would judge from these figures that most clay upland which has only natural surface drainage may, probably, be made to produce a profitable increase in yield by under draining with tile.

INFLUENCE OF UNDERLYING WATER.

Alfalfa has been reported as growing on soil with water ranging from 1 to 150 feet below the surface. No yields, however, have been reported where water lay permanently within 3 feet of the surface. There are many cases where the alfalfa seems to be flourishing with the water lying at a depth of from 4 to 8 feet below the surface. In fact, some of the very heaviest yields seem to have been produced on such land, and the cases are extremely few where the yields indicate any injury from water at that depth.

INFLUENCE OF FLOOD-WATER.

Many had had alfalfa land covered with water for a greater or less length of time, and 34 had suffered some loss or injury. Some alfalfa was killed by two days' flooding, but other alfalfa did not seem to have been injured after two weeks of water covering. It seems quite evident that injury is occasioned only when the life processes of the plants are active. During the winter the plants may not be injured for a considerable time unless the water freezes solid, but when the crop is growing the plants may be killed if the water covers them no more than two days.

IMPORTANCE OF HUMUS.

Of all the soil, in all of the different soil classes, 53 per cent was reported as rich, with an average yield of 4.1 tons per acre; 29 per cent was classed as fairly rich, with an average yield of 3.67 tons per acre, and 17 per cent was classed as poor in humus, with an average yield of 3.60 tons per acre. The effect of the different amounts of humus in the different soil classes is seen below:

TABLE VII—EFFECT OF HUMUS IN THE SOIL.

Character of soil	Amount of humus	Number of acres	Number of reports	Below 2½ tons per acre	4½ tons or more per acre	Average yield per acre, tons	Per cent of increase over poor soil
Clay	Rich	428¾	42	4	16	4.25	28 7
	Fairly rich	141	22	2	6	3 75	13.6
	Poor	126¾	27	3	2	3.30	
Sandy	Rich	208½	22	1	12	4.50	28.6
	Fairly rich	63	8	1	2	3.50	
	Poor	57	7	I	2	3.50	
Undescribed	Rich	274½	30	2	16	4.13	12.5
	Fairly rich	546½	15	1		3.80	03.5
	Poor	10¾	9	1	1	3.67	

An inspection of the table shows that both clay soil and sandy soil give fully 28.5 per cent more hay when rich than they do when poor in humus. The rich soils of unknown character are, also, more productive than the poor soils of the same class—the difference being 12.5 per cent. These figures seem to give ample evidence that alfalfa, like most other crops, appreciates a liberal amount of humus in the soil.

MANURE.

Manure had been used in the preparation of seed-beds and upon alfalfa in 188 cases. Our questions were not so framed as to bring forth any definite values coming from these applications, but various statements were volunteered which indicated that manure was in high esteem among most of these growers. When manure was applied at, or but shortly before seeding time the trouble from weeds was often increased, but where the precaution is taken to apply the manure to a preceding crop, like corn, or the seeding postponed until after the weed-seeds have sprouted and the young weeds been killed, this difficulty may be avoided.

Alfalfa that is several years old may usually be manured with benefit at the beginning of the season or between cuttings. When manure is applied at these times, it will, probably, be found advisable to disk it into the surface soil to prevent its being collected in the hay. The disking will act as a cultivation to the crop and may have the additional value of thickening the stand.

THE INFLUENCE OF THE FORM AND LOCATION OF THE NATURAL LIMESTONE.

TABLE VIII—A COMPARISON OF YIELDS ON SOILS CLASSED ACCORDING TO THE NATURE OF THE LIMESTONE DEPOSITS.

	Number of acres	Number of reports	Below 2½ tons per acre	4½ tons or more per acre	Average yield per acre
Limestone gravel in surface soil.....	658	70	5	29	4.20
Limestone gravel in sub-soil.....	187	14	0	5	3.70
Limestone not apparent.....	147	15	3	6	3.60
Limestone outcrop in locality.....	243	26	2	11	3.43

In the above table the group of soils designated as "limestone not apparent" should not be considered as being free from limestone, for many of the fields included therein are located in counties, such as Preble and Champaign, which have pronounced limestone soils. In the majority of cases it simply means that the limestone is present but is so thoroughly incorporated in the soil that it is not noticeable. Also that there is no nearby outcrop of limestone to indicate that the soil might be but a recent product of the stone, or that it was receiving new supplies from outcrops adjacent, but on a higher level.

The above figures seem to emphasize the importance of actually knowing that the surface soil contains a sufficient amount of limestone. It seems no sure indication that the soil will be properly neutralized when there is limestone gravel in the subsoil or when there is an outcrop of the stone in the locality. Individual cases have been found where alfalfa grew successfully, and completely refused to grow at all, within the limits of a few rods, apparently entirely because of a difference in lime requirement. Acid soils are sometimes found over limestone gravel sub-soils, and in hillside and upland fields, no more than one-half mile from limestone quarries and completely surrounded by hills which are little more than masses of limestone rock.

RESULTS OF CO-OPERATIVE TESTS WITH LIME AND INOCULATION.

The Co-operative department of the Experiment Station, during the past season, has put out among the farmers of the state a large number of alfalfa tests, the object of which has been to aid the farmer in determining whether alfalfa growth upon his soil will be

benefited by an application of lime, and also to determine, if possible, whether inoculation is of practical value, and, if so, the relative merits of old alfalfa soil and the liquid cultures sent out by the United States Department of Agriculture.

The land was usually plowed in April or early May, and worked frequently to kill weeds and conserve moisture up to the time of planting, which varied from May 19th to August 16th. Four comparable plots were laid out and handled as follows: Plot 1 was seeded without further treatment; Plot 2 was sown with seed that had been treated with the government liquid culture; Plots 3 and 4 were both inoculated with soil obtained from an old alfalfa field; Plot 4 was given an application of lime in addition to the inoculation. Usually the lime was applied several weeks before planting, but in one instance, at least, in the comparisons below, lime was applied on the date of seeding, with the result that the alfalfa was so injured that Plot 4 was ranked last.*

Various notes were taken throughout the season by the co-operators as they found occasion to do so, but at the close of the season all co-operators compared the alfalfa growing on the different plots and gave each plot a rank (1st best, 2nd best, etc.) according as they found the vigor, stand, etc. Fifty co-operators made reports upon tests which were fully comparable, and the ranking of these plots of alfalfa as they saw them, at the close of the season, is given in tabular form below.

SUMMARY OF FIFTY CO-OPERATIVE TESTS WITH LIME AND INOCULATION.

Plot 1—No treatment.

Ranks	1st	in	4	cases
"	2nd	"	5	"
"	3rd	"	6	"
"	4th	"	18	"
Failed		"	3	"
Similar to others		"	14	"

Plot 2—Seed treated with government liquid culture.

Ranks	1st	in	2	cases
"	2nd	"	4	"
"	3rd	"	19	"
"	4th	"	6	"
Failed		"	5	"
Similar to others		"	14	"

Plot 3—Inoculated with alfalfa soil.

Ranks	1st	in	2	cases
"	2nd	"	23	"
"	3rd	"	7	"
"	4th	"	1	"
Failed		"	3	"
Similar to others		"	14	"

Plot 4—Limed and inoculated with alfalfa soil.

Ranks	1st	in	29	cases
"	2nd	"	4	"
"	3rd	"	0	"
"	4th	"	3	"
Failed		"	0	"
Similar to others		"	14	"

The plot treated with lime and soil inoculation was superior to all others in 29 out of 50 cases, and since Plot 3 was treated with soil inoculation also, and is reported as holding first place in but 2 cases it is quite evident that the superiority of Plot 4 is to a certain extent, at least, due to the influence of the lime applied. It thus appears that

NOTE—*Further details concerning co-operative tests may be had by writing to the Experiment Station.

58 per cent of the farmers co-operating can use lime with advantage in the growing of alfalfa, and in some cases it is quite evident, from other data furnished by those reporting, that the limed plot was the only one which could give permanent results. It is quite probable that, in some instances, where lime has not favored the growth the first season, the effect may become apparent at a later date.

The most of the tests have been located in those counties which are not among the so-called limestone counties and, of course, would be expected to show a high per cent of soils requiring lime; yet out of the 6 tests tests that have been located in a strictly limestone region, 5 showed that alfalfa was benefited by the use of lime.

In considering the practical value of inoculation for alfalfa, it seems evident from the above ranking that, at least, in very many cases, there was an appreciable advantage given to all the plots which were inoculated, but particularly is this true in the case where alfalfa soil was used. In comparing the results from the use of the government liquid culture with the results from the use of soil, it is evident that the contest is for second place, since the plot with lime and soil inoculation stood first. It will be seen that the liquid culture held second place in 4 tests and that the soil plot held second in 23 tests or, in other words, the first honors were held by soil inoculation nearly 6 times as often as by the liquid culture inoculation.

On November 1st the height of the alfalfa in all the tests was taken and below is given a comparison of the average heights of plants in each of the four plots and also the per cent of increase due to the different treatments.

TABLE IX—VALUE OF LIME AND INOCULATION TREATMENTS COMPARED IN INCHES OF GROWTH.

	Check	U. S. D. A. liquid culture	Soil inoculation	Lime and soil inoculation
Average height—inches	5.1	5.4	7.3	8.5
Per cent of increase	.....	6	43	67

As a result of this co-operative work, we can hardly help granting that value may often come from the use of inoculation when starting alfalfa, particularly where old alfalfa soil is used. It is impossible for us to advise at the present time as to the proper amount of soil to use, but probably not less than 100 or 200 pounds per acre. It should be remembered that the close contact of the inoculated soil with the seed favors more certain and prompt results. A combination seed and fertilizer drill may be used to accomplish this, or if the inoculated soil is dry and the precaution is taken to sift it, the seed may first be mixed with the soil and the two drilled together.

It has been announced by Dr. C. G. Hopkins, of the Illinois Experiment Station, that soil from about the roots of sweet clover plants will serve to inoculate alfalfa also, and a pot test at the Ohio Station seems to support this statement.

In preparing alfalfa or sweet clover soil for use it should not be dried in the sunlight, as the direct rays may kill many of the bacteria. For this reason, also, care should be taken in broadcasting the soil not to allow it to remain in the sunlight without harrowing.

INFLUENCE OF A PRECEDING CROP.

Alfalfa has followed almost the whole list of other crops, but those which have most frequently preceded alfalfa are corn, clover, wheat, potatoes, oats and timothy, arranged according to the number of times they have been represented—corn leading in a large majority of cases. We find that the clover and potato lands have led with about an equal yield and are followed in the order of their yields by corn, timothy and oats. The very highest yields have come from old garden and tobacco soils. The chief point of interest in these facts is the evident advantage which comes from the richer soils.

Clover land usually contains a comparatively large quantity of organic matter in the form of manure, roots and stubble; the potato land has usually been well manured and fertilized, and the garden is always the richest spot on the farm. The tobacco land seeded to alfalfa was naturally fertile, and in addition, of course, had been fertilized and given good cultivation.

AMOUNT OF SEED TO USE.

From 7½ to 90 pounds of seed are reported to have been used on one acre of land. The twenty-acre field which was seeded with only 7½ pounds of seed per acre is said to have given an average yield of 4½ tons of hay per acre, and the various fields having been sown with from 10 to 12 pounds of seed per acre are said to have given yields ranging from 3 to 4½ tons per acre.

On the other hand, no complaints have been reported where the larger amounts of seed were used, and a considerable number, who, in the past, have used from 15 to 20 pounds of seed, state that they prefer using more seed.

Various writers and speakers have correctly shown that 20 and even 15 and 12 pounds of seed is an extravagant waste of seed when even a reasonable per cent of the seeds produce plants. It seems in most cases where heavier seeding has been considered an advantage that the main object was to combat weeds, or, in other words, to make the extra amount of seed serve the purpose of a nurse crop.

Alfalfa seed, of course, is rather expensive to be used for the production of a nurse crop, but it is quite probable that it is as good

as or better than some of the regular crops used for nurse. As will be seen in that which follows, however, we prefer to combat weeds with clean culture.

The amount of seed that will be required will depend upon the perfection of the seed-bed, the kind of soil and the condition of the weather at time of sowing. The more perfectly the seed-bed is supplied with food and moisture and cleared of weed-seed, the less seed will be required. Sandy soils will usually demand a little more seed than the finer grained soils. In seasons when the weather is especially unfavorable (exceptionally cold, wet or dry) more seed should be sown, also. Under average conditions as now found on the farm, from 15 to 20 pounds of seed is, at least, a safe amount to use. As the importance of a weed-free seed-bed becomes better appreciated and the land becomes more generally inoculated this amount can likely be reduced.

METHODS OF SEEDING AND SOIL REQUIREMENTS.

The most common practice has been to sow broadcast and harrow lightly. It has also been frequently seeded with a drill. When the drill is used some find it advisable to allow the seed to be scattered in front of the drill hoes. It is usually considered very necessary not to cover the seed deeply, especially if the soil is of a clayey nature. On sandy soil the seed should be planted deeper, and it will often be found advisable, in some way to compact the soil over the seed.

Alfalfa has been sown upon practically every date between March 14th and September 2nd and has failed, has been a partial success, or has been all that could be desired in return for different seedings at each of the various dates.

Seeding alone, seeding with oats, with barley and with each of the various crops, such as corn, wheat, rye, buckwheat, clover and timothy have each been condemned and some one method lauded; yet an inspection of Table X shows no startling differences when average yields are compared.

TABLE X—METHODS OF SEEDING COMPARED.

Method of seeding	Number of reports	Below 2½ tons per acre	4½ tons or more per acre	Average yield per acre, tons	Per cent reporting weeds
With oats	79	8	29	4.13	20.2
With barley	31	2	12	3.95	38.7
Seeded alone (mostly early)	105	3	36	3.94	27.6
Miscellaneous crops	21	0	9	4.25	28.5

There is undoubtedly no other point so important, as seen in the experience of the Ohio alfalfa grower, as the need of a more careful observance of alfalfa's soil requirements.

Some men are failing while others are succeeding in the culture of alfalfa, and both classes of men are represented in practically every combination of agricultural conditions.

Every common class of soil, whether upland, bottom land or second bottom land, has refused to grow alfalfa for some men, and yet for some others each soil has returned most flattering yields.

The urgent need of thorough drainage, the fatal results from flood water when covering the growing plants, the absolute necessity of lime in many instances, the importance of having the soil well stocked with humus, and even the probable advantage from soil inoculation may be and often are clearly understood, but the confusion resulting from the various experiences in regard to time, to quantity of seed and to methods of seeding is almost disheartening to the beginner who is earnestly desiring definite advice in the growing of this crop.

All those contemplating the growing of alfalfa should remember that the one main object in preparing the seed-bed is to provide for a suitable amount of air, moisture and plant-food for the sprouting seed and the young plant. It should be thoroughly understood that alfalfa plants are especially desirous of abundant sunlight. Shading is practically always detrimental, and if the shade is sufficiently intense, as is the case in a dense growth of weeds, the results may be fatal.

It is the common experience, all over the state, that on well drained land, supplied either naturally or artificially with sufficient limestone and humus, alfalfa is even then often forced into a hopeless struggle for moisture, plant-food and sunlight.

Of those reporting, 253 stated that at some time they had experienced partial or complete loss when seeding alfalfa. Various causes were given for these failures, but the chief ones were lack of lime; winter-killing; dry weather; water in the form of heavy rains, flood water or poor drainage; nurse crops and weeds.

The following figures show the number of times each cause was mentioned.

TABLE XI—CAUSES OF FAILURE TO SECURE ALFALFA COMPARED.

	Lack of lime	Winter killing	Dry weather	Rain, flood-water or poor drainage	Nurse crops	Weeds	Early seeding alone
Number of cases.....	10	18	18	43	53	107	7

These figures show weeds to be by far the most serious of all the troubles. A further inspection of Table X shows, also, that from 20.2 per cent to 38.7 per cent of those succeeding with alfalfa have reported that their present alfalfa had been seriously injured by weeds.

THE NURSE CROP.

It will be noticed from the above table that the nurse crop has also been quite a source of loss, even being more serious than the combined injuries of washing rains, flood water and poor drainage. It seems extremely likely, also, that a high per cent of the losses due to dry weather are really due to a nurse crop. For out of the 18 cases where drouth was reported to have injured the alfalfa, 14 had been sown with a nurse crop, and only 4 where no nurse crop was used. Of these 4, three had been sown very late on sandy or gravely soil. The other one was sown in May during a drouth.

So serious has been the weed problem in starting alfalfa that various methods have been devised for combating them. The nurse crop sown with alfalfa is, in part, for this purpose.

There is little doubt but that the nurse crop, if sufficiently thick, will hold many kinds of weeds in check until it has been removed. However, it is plain that the same principles which prevent weeds from starting must necessarily hold the still weaker alfalfa plants in check.

It will be seen by a still further inspection of Table X that none of the nurse crops are a sure preventive of weeds. This is due in part to the fact that many of the weed seeds still remain in the soil after the harvest of the nurse crop, and if they are numerous and for any reason the young alfalfa does not at once fully occupy the space left by the nurse crop—and this is often the case—the old trouble again becomes manifest.

It will be seen that alfalfa which was sown with oats is freer from weed injury than that from any other method of seeding. This, of course, is what would naturally be expected, for the oat crop produces a denser shade than any of the other crops used for that purpose, and the chances for weeds to start are lessened.

It should not be understood from this, however, that seeding with oats is the most desirable method, for fully 41.5 per cent of the losses due to nurse crops have been where oats was used. The facts are, not only weeds, but alfalfa, as well, finds it difficult to survive the severe competition for moisture, food and light.

After oats, barley is the next most common nurse used with alfalfa, and only 15.1 per cent of the losses were credited to it.

It seems on the whole that barley is a much safer crop than oats to use with alfalfa, but as was seen in Table X, it does not accomplish the most important primary object (eliminating the weed problem) or, at least, 10 per cent more have reported injury from weeds when using barley than when the alfalfa was seeded by itself. It is evident that, in many cases, the barley has so weakened the young alfalfa that it cannot maintain its possession of the land after it is left alone, or that the shading was so little that weeds gained a foothold in spite of the nurse.

In rich, limestone soil, which is retentive of moisture and which has been cleaned of weed seed by the cultivation of a previous crop, like corn, there is no question but that barley may often be seeded with alfalfa with profit, since more or less grain or hay may be harvested the first year, while the alfalfa is becoming established, and this with, perhaps, no permanent injury to the alfalfa crop.

Alfalfa has also been sown with wheat, but of those trying this method only two recommend the practice, while 10 state that they failed by seeding with it.

Corn, rye, peas, buckwheat, clover and timothy have also been used as a nurse for alfalfa, but too little experience is reported concerning them to furnish us with any definite idea of their value.

In the light of personal experience many growers of alfalfa have found it advisable to make various changes in their methods of seeding.

The number reporting changes from seeding with oats to seeding alone, changes from seeding with barley to seeding alone, changes from seeding alone early to seeding late or after the weed seed has been destroyed, changes from seeding with oats to seeding with barley, changes from seeding alone to seeding with nurse crop and those seeing fit to continue seeding with oats, seeding with barley and seeding alone early, are compared in the following table:

TABLE XII—TO CHANGE, OR NOT TO CHANGE.

From what to what	Oats to seeding alone	Barley to seeding alone	Seeding alone early to seeding alone later	Oats to barley	Alone early to nurse	Continue with oats	Continue with barley	Continue alone early
Number.....	43	16	57	6	7	25	14	20

It is clearly seen by the above figures that experience is leading to the abandonment of the use of the nurse crop, and is forcing the grower of alfalfa to meet the weed problem squarely in the open field by destroying the weed seed before planting the alfalfa seed.

Fifty-seven growers of alfalfa reported that they had sown alfalfa late in the season, ranging from July 1st to September 2nd.

In this number of trials, weeds had done serious injury in but four cases. In one of these cases the seed had been impure. In another one the alfalfa was impeded in its growth for want of lime in the soil. Doubtless the weeds in the other two cases could as easily have been accounted for had the report sheets been completely filled out.

Three of the 57 men propose seeding early in the future, evidently because their soils are too sandy or gravely to retain a proper amount of water, if the weather becomes dry. Two men with clay soils and clay sub-soils, propose seeding with spring barley in the future but do not give their reason. It is quite probable that these individuals were unsuccessful with late seeding because of poorly prepared seed-beds—their reports showing that they did not plow until in August and then seeded in the same month.

While the above evidence shows much in favor of late seeding, we do not wish to convey the idea that the *date* is entirely responsible for success. The success of late seeding is simply due to the fact that the young alfalfa has been given the entire benefit of all sunlight, moisture and plant-food, through the absence of both nurse crop and weeds. With these conditions and an otherwise fertile soil, alfalfa will succeed by sowing at practically any time from early spring to the middle of August.

If the cultivation of a previous crop can be made to thoroughly rid the land of weed-seed, then so much the better, for both the previous crop and the alfalfa will be benefited and no special time will have to be taken. If the seed-bed has not been cleaned of weed-seed in a previous season then the land should be plowed in the spring as early as the work can be done and done well; after this every effort should be made to cause the weed-seed to germinate, by compacting the soil and conserving moisture, and as often as the weeds start they should be destroyed by such surface tillage as is found necessary. If the weather is warm and moist, a crop of weeds may be destroyed every ten days or two weeks.

The seeds of summer and fall grasses, such as foxtail and crab-grass, do not start to germinate freely until the soil becomes well warmed by the summer's sun, and for this reason it is well to continue the cultivation for weed killing until these two worst of all weed pests in Ohio have been destroyed. This will not often be before the 1st of July—usually a week later—and in some cases, where the land is especially foul or the weather such as to hinder the destruction of weeds, not before the first part of August.

After it is evident that most of the weed seeds are destroyed, we advise seeding at as early a date as is possible, so that the alfalfa may become sufficiently established to give a full season's crop the following year.

If the soil and sub-soil are retentive of moisture they will, with but few exceptions, be suitably moist for starting the alfalfa at the end of the tillage for weeds, even though the weather has been exceptionally dry. We do not consider it necessary to have wet weather for seeding if the soil contains plenty of moisture, but, if for any reason the soil should be dry at the depth the seed is planted, then we advise postponing the seeding until a good supply of moisture has accumulated

A number of our growers report success with alfalfa by seeding after potatoes. These reports do not make it clear whether the alfalfa followed potatoes the same season or not, but we believe that this might often be done after early potatoes. The potato land has usually been well fertilized and manured, and if the cultivation has been suitable most of the weed-seed will have been sprouted and the weeds killed by the time the potatoes are removed. The alfalfa seed may be sown after this if sufficient moisture is present.

It is most difficult to secure a catch of alfalfa upon sandy or gravely soils, because of their inability to retain moisture for any considerable length of time. For this reason, we advise seeding such soils at a time when the most abundant moisture may be expected. With such soils it will, probably, be found a good plan, in most cases, to destroy the weed-seeds by the cultivation of a previous crop, like corn, and then seed the land to alfalfa in the spring without plowing. A heavy coating of manure will greatly aid these soils to retain moisture. The manure should be applied to the preceding crop.

It should be remembered, by those who depend principally upon the cultivation of the former crop for the eradication of weed-seed, that if the soil is plowed deeply again in the spring another set of weed-seeds may be brought to the surface and these, of course, will be as serious a menace as any. If the preparation of the seed-bed and cultivation of the preceding crop have been thorough and careful, there is probably no need for plowing the land again in the spring, because alfalfa desires a compact seed-bed and its roots are of such a character that they will readily penetrate our most tenacious soils, if they are well drained.

Alfalfa appreciates a seed-bed which has in the past had an abundance of manure deeply incorporated throughout the soil, but in no case would we think it advisable to plow the land, previous to seeding alfalfa, to a greater depth than it had ordinarily been plowed. Raw sub-soil brought to the surface in this way may be a decided injury, and as has been indicated, the loosening of the soil to the extra depth will probably have no advantage.

CLIPPING YOUNG ALFALFA.

Clipping has usually had two main objects—to prevent the weed growth from smothering the young alfalfa and to stimulate a more vigorous growth. From what has been said, it will be seen that, at best, the practice is a poor method of combating weeds. Numerous correspondents have, also, furnished abundant evidence that clipping had been of little or no value in saving the young alfalfa from weed-growth, and quite frequently it has been stated that the young alfalfa has been actually injured or completely killed by the clipping itself.

We are unable to find any evidence that alfalfa which has not in some way—by disease, maturity, etc.—had its growth checked, has ever been benefited by clipping. It is quite probable, however, that when the growth has once been checked and the tops seem to be dying, clipping should be employed. It seems to be the quite general experience, also, that the plants should always be clipped as soon as they come into bloom, or before seed-pods begin to form.

CUTTING ALFALFA FOR HAY OR OTHER FEED.

It seems to be the experience in Ohio that alfalfa may be injured, or the growth injured for the rest of the season, either by cutting when too young (before blossoms appear) or by allowing the crop to become too old before cutting.

The former injury is not understood, so far as known, and while sometimes it is brought clearly before our notice it has not been experienced in many cases. It is quite generally agreed, however, that late cutting lessens the value of the hay and decreases the yield of subsequent cuttings that year.

PASTURING ALFALFA.

Of the 109 giving definite answers to the question relating to the effect of pasturing alfalfa, 61 stated that they had experienced no ill effect and 48 that they had pastured with bad results to the crop. In most cases we were unable to learn the exact age and conditions under which the pasturing was permitted. Yet, we believe we are safe in stating that alfalfa will practically always be injured by pasturing the first season, and that it is an extremely doubtful practice even the second season. Moreover, heavy pasturing at any age, will probably always shorten the life of the stand. So valuable is the crop for pasturing hogs and horses, however, that some men claim that they can well afford to pasture after the first year, even though it will last but one or two seasons.

ALFALFA FOR ENSILAGE.

Five reported that they had used the crop for ensilage, and in each case the results were considered very successful.

ALFALFA FOR SOILING.

Alfalfa had been used for soiling livestock in 30 instances, and all reported very satisfactory results so far as its value as a feed is concerned, but some stated that the repeated cutting of the immature plants had been fatal to the alfalfa.

SUMMARY.

The climate of all parts of the state is suited to the growth of alfalfa.

The success with which alfalfa is growing in all parts of Ohio, upon soils of such widely varying character, would indicate that there are few farms which do not have some land upon which it can be made to grow successfully. No one type of soil, nor no particular elevation has a monopoly of favorable conditions.

Upland clay and sandy first and second bottoms have produced the heaviest maximum and average yields.

Sandy upland and clay first and second bottoms have produced the lowest maximum and average yields.

Good yields and poor yields have been produced on all classes of soils, including muck, and some fields, having failed one or more times, have been made to produce good yields by a different method of procedure.

The presence or absence of drainage, humus, limestone and inoculation, and the degree of perfection of the seed-bed have usually been the controlling factors responsible for the varying successes.

Water-logged soils, soils with water lying permanently within 3 feet of the surface, and soils which become covered with water during the growing season for 2 days or more are not suitable for alfalfa.

The yields on clay upland with natural surface drainage were 12 per cent greater where tiles were also used.

Sandy soil, or soil with very porous sub-soil, is usually not sufficiently retentive of moisture to insure certain results on upland.

All soils reported to heave the alfalfa were either poor in drainage, or in humus, or in both combined.

The average yields from soils rich, fairly rich, and poor in humus were respectively 4.25 tons, 3.75 tons and 3.33 tons per acre.

An application of 8 tons of manure increased the yield by 1,347 pounds per acre at the Ohio Experiment Station. Manure is also in high esteem with many growers over the state. It should be applied to a preceding crop, or a sufficient time before seeding to allow the weed-seed to be destroyed.

When the soil is acid alfalfa will not succeed until sufficient lime in some form, is applied and worked into the soil.

Lime will most often be needed in sections where there is no limestone apparent, but not all fields in these sections will require it, nor will all fields in those sections where there are limestone outcrops in the locality or limestone gravel in sub-soil be sufficiently supplied. Fields on hillsides and upland usually become acid before those on bottoms.

When in doubt whether the soil needs more lime, it will probably be best to make a small test with different amounts of lime before launching heavily into alfalfa growing. Lime has been tried without results, in some cases, when really needed, because insufficient quantities had been used or because insufficient time was allowed for it to act before the seed was sown.

A large number of tests in different parts of the state have shown inoculation to have value. Inoculation with soil was found much better than inoculation with liquid cultures.

From 15 to 20 pounds of seed is considered a safe amount to use under average conditions—the more perfect the seed-bed and the more complete the inoculation the less seed will be required.

Weeds are the greatest enemy the alfalfa crop has. The methods of combating frequently resorted to—nurse crop, heavy seeding of alfalfa and clipping are not advisable.

The weed-seed should be destroyed by the cultivation of a preceding crop or, as will more often be necessary, by fallow cultivation during the fore part of the season. The cultivation should be continued until this purpose is accomplished.

The date of seeding will depend upon the success which has been attained in this combat with weeds. Alfalfa may be seeded any time after spring frosts are over until the middle of August. The earlier the better if the *seed-bed is in proper condition*. As a rule this will not be secured before July. Late seeding is of no value in itself; it merely makes possible the cleaning and compacting of the seed-bed and the avoiding of all "nurse" crops of foxtail, crab-grass, oats, barley, etc. Upon loose or porous soil, early seeding is frequently necessary in order to meet the moisture requirements.